Special SEG Workshops

Thursday Afternoon

Workshop I—Reconciliation of Seismic, VSP, and Sonic Log Data

Speakers:

B. R. Tittman, Rockwell Corp.
B. A. Hardage, Phillips Petroleum Co.
R. Wiggins, Schlumberger-Doll Research
M. M. Backus, Univ. of Texas, Austin
A. H. Balch, Mobil Research & Development
J. P. DiSiena, Arco Oil & Gas Co.
J. E. White, Colorado School of Mines
M. N. Toksöz, M.I.T.

Workshop II—Electromagnetics

Comparison of Numerical and Laboratory Scale Models W2.1

Alex Becker and H. Frank Morrison, Univ. of California, Berkeley

Numerical Modeling of Transient EM Responses W2.2

Gerald W. Hohmann, Univ. of Utah

Transient EM (TEM) techniques have gained widespread acceptance in the last five years. However, numerical simulation of TEM responses of 2-D and 3-D bodies in the earth is still in its infancy. Results can be calculated directly in the time domain, or indirectly by Fourier transformation of frequency domain results. The former method permits the study of the evolving current system in the earth, a necessity for gaining insight into TEM behavior. However, the latter method probably is more efficient for cases where several transmitter positions are desired. Numerical solutions by these methods are required both for their particular advantages and for validation of results.

We achieved an accurate and stable 2-D solution in the time domain using an explicit finite-difference technique; no matrix inversion is required. About 2 000 time steps are sufficient for computing to 35 ms, if the problem is formulated in terms of the secondary field of inhomogeneities in the earth. Results compare well with Fourier transformed values computed in the frequency domain using finite-element and integral equation techniques. Two-dimensional models are useful for studying profile shapes, but they do not account for current channeling, and they do not have the correct late-time decay.

Initial results were computed using a 3-D finite-difference formulation based on a time-stepping solution for the secondary magnetic field. In this formulation the three components of the field are coupled only at conductivity boundaries, and complex subsurface distributions of conductivity can be simulated. However, two new integral equation solutions, although limited to single prismatic bodies in the earth, already have provided new insight into TEM behavior.

In one method, a volume integral equation for the electric field is solved in the frequency domain, and transient results are computed by Fourier transformation. In order to reduce the number of expensive frequency-domain values required, the Fourier transformation is accomplished via the decay spectrum. Usually only 10 frequencies are required. In the other 3-D method, we formulate the integral equation in the time domain and solve it by time-stepping. At each time step the tensor Green's function is convolved with past values of the scattering current. Incorporating a set of divergence-free basis functions in addition to the standard pulse basis functions results in a solution that is valid at high contrasts. A free-space version of the solution is useful for comparing